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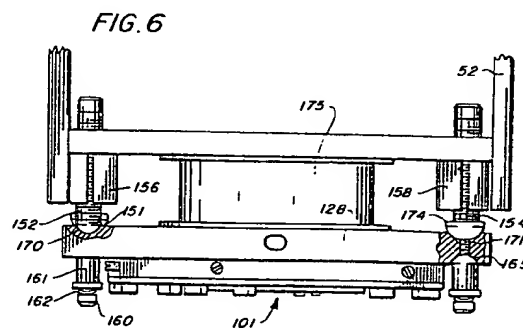
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54 Array alignment apparatus for a raster scanner.

57 Array adjusting apparatus for a raster scanner with scanning arrays (40, 41) supported by displaceable blocks (106, 108). The blocks are supported against a spring bias 132 on members 116, 117, screws 120 permitting the members 116, 117 to be moved to raise and lower arrays 40, 41 and thereby adjust the height of the arrays within the optical system (55-59). A side member (140) permits, through screw 120', adjustment of the array position in the optical path along the horizontal. Screw members (152, 154) enable adjustment of the array focus, with pivot means (174) permitting pivoting of the array to bring the array into perpendicular relationship with the optical path.



ARRAY ALIGNMENT APPARATUS FOR A RASTER SCANNER

This invention relates to an array adjusting apparatus for a raster scanner to permit the scanning arrays to be aligned in the optical system.

In raster scanners of the type employing one or more scanning arrays, alignment of the scanning array in the optical path and with the image plane is critical for satisfactory image output. This includes aligning the array for focus, for skew, for height, and for lateral position. And, in the case where multiple scanning arrays are used, the arrays must be physically positioned so that the array viewing fields overlap in order that crossover from one array to the succeeding array on readout can be made at the desired point.

The small size of the array chip however, makes the arrays difficult to handle physically and difficult to locate accurately in the system. And current array construction and fabrication techniques, which place a premium on packing the largest number of photosensitive elements on the smallest possible chip, further add to the difficulty in locating the array or arrays with the extreme accuracy required. Indeed, some recent commercially available scanning arrays have over 1700 photosensitive elements.

Compounding the difficulty is the practical need to accommodate changes in array alignment brought about by use and handling of the raster scanner. While laboratories and manufacturing environments may contain the specialized and often highly sophisticated equipment and the technically trained people necessary to initially make the needed array alignment with the high degree of accuracy required, later realignment of the scanning array or arrays in the field by the user or even by service personnel may not be possible due to a lack of accurate alignment apparatus.

To solve the foregoing and facilitate aligning of the scanning array or arrays of a raster scanner having a platen for supporting an original to be scanned and optical means forming a path for image rays between the platen and the array or arrays, the present invention provides an array support incrementally adjustable along a path parallel to the axis of the optical means and along axes perpendicular to the optical axis to enable the array to be brought into focus and to be moved up and down and sideways for alignment.

The present invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 is an isometric view of a terminal (IIT) embodying the present invention;

Figure 2 is a side view in cross section of the IIT;

Figure 3 is a top plan view of the IIT;

Figure 4 is an enlarged view showing details of the optical system for the IIT;

Figure 5 is an end view in section of the mounting mechanism for the IIT scanning arrays;

Figure 6 is a top view in section of the scanning array support; and

Figure 7 is an exploded isometric view showing details of the scanning array support.

Referring particularly to Figures 1-4, a scanner 12 includes a frame or housing 18 consisting of base 20, side walls 21, 22, front and rear walls 24, 25, and top wall 26. Base 20 and walls 21, 22, 25, 26 cooperate to form an interior chamber or compartment 27 within which a movable scan carriage 32 is disposed. Base 20 and walls 21, 22, 24, 25, 26 of housing 18 are planar, top wall 26 including a generally rectangular transparent glass or platen 28 through which the original document 8 to be scanned is viewed.

Document handler 14 normally overlays platen 28, the document handler 14 serving to bring one document at a time forward into registered position on platen 28. Following scanning of the document, the document is removed by document handler 14 to clear platen 28 for the next document as will appear more fully herein. Where document handler 14 is not used, the document to be scanned, i.e. a book (See Figure 13) is manually placed on platen 28 in registered position. Following completion of scanning, the document is manually removed. In this mode of operation, document handler 14 is swung to an out of the way position or removed. See Figure 11. Preferably where document handler 14 is removed, a suitable platen cover (not shown) is provided to prevent glare and permit platen 28 to be covered when not in use to protect the surface thereof from scratches, dust, etc.

The portion 30 of top wall 26 between the end of platen 28 and front wall 24 is preferably beveled or sloped downwardly to provide a supporting surface facilitating scanning of bound originals such as books.

When scanning bound originals, document handler 14 is placed in an out-of-the-way position or removed entirely.

Scan carriage 32 is supported for longitudinal movement (in the Y direction) within compartment 28 of scanner 18 by means of parallel carriage support rods 34, 35. Carriage support rods 34, 35 are carried in front and rear walls 24, 25 of housing 18. To support carriage 32 on rods 34, 35, front and rear journals or bearings 36 are provided on the sides of carriage 32, bearings 36 slidably riding on rods 34, 35.

To impart scanning motion to carriage 32, a drive screw 37 is threadedly engaged with carriage 32 via nut 38. Reversible drive motor 39, which is supported on base 20 of housing 18 adjacent rear wall 25, drives screw 37 in either a clockwise (scan) or counter clockwise (return) direction to move carriage 32 longitudinally along carriage support rods 34, 35.

A pair of scanning or image arrays 40, 41, which may for example, comprise Fairchild Model 121 H CCD Chips, are supported on carriage 32 adjacent one end thereof in predetermined spaced relation such that array 40 is above and to one side of array 41. Arrays 40, 41 each comprise a series (e.g. 1728) of individual photosensitive elements effective when exposed to the document being scanned to generate a signal whose potential is proportional to the reflectance of the image area seen by the array element.

An optical system consisting of lens 55, scan mirror 56, and reflecting mirrors 57, 58, 59, cooperate to form an optical path 54 through which image rays reflected from a document on platen 28 are transmitted to arrays 40, 41. Lens 55 is mounted substantially centrally on carriage 32 in preset spaced opposing relation to arrays 40, 41. Mirrors 56, 57, 58, 59, which are generally rectangular in configuration, are mounted on carriage 32 in preselected angular dispositions to provide a folded optical path between platen 28 and lens 55. Mirror 59 has two facets 61, 62 disposed at predetermined angles with respect to one another such that mirror 59 serves as an object beam splitter to split the projected image into two images, one for each array 40, 41. During scanning, image rays reflected from the document on platen 28 pass downwardly to scan mirror 56 and from scan mirror 56 through mirrors 57, 58, 59 to lens 55 and arrays 40, 41.

To illuminate platen 28 and any document thereon, an elongated exposure lamp 65 is provided on carriage 32. Lamp 65 which

extends in the direction generally perpendicular to the direction of movement of scan carriage 32, is disposed in a generally cylindrical lamp housing 66. A slit-like exposure aperture 67 in lamp housing 66 extends across the width of platen 28. The interior walls 69 of lamp housing 66 are preferably polished to reflect light from lamp 65 toward aperture 67 and platen 28.

A reflector 70 is provided opposite aperture 67 to further reflect light emitted by lamp 65 onto platen 28 adjacent the image scan line. Reflector 70, which is disposed on the opposite side of optical path 54, is pivotally supported by pins 72 on carriage 32. Spring 73 biases reflector 70 in a counter-clockwise direction into engagement with fixed locating stop 74 on carriage 32. The upper surface of reflector 70 is beveled at 75 and cooperates with the downwardly sloping interior portion 30 of top wall 26 on movement of carriage 32 to a home position to pivot or swing reflector 30 forwardly (to the dotted line position shown in Figure 4).

During operation, lens 55 and mirrors 56, 57, 58, 59, and exposure lamp 65 and reflector 70, move (in the Y direction shown by the solid line arrow of Figures 2 and 3) from the carriage home position to the end of scan 81 to scan the document 8 on platen 28. Light from exposure lamp 65 illuminates a line-like area i.e. the scan line, across the width of platen 28 (in the X direction shown by the dotted line arrow of Figure 3). As carriage 32 moves under platen 28, the line-like illuminated area travels the length of platen 28. Following completion of the scan, carriage 32 returns to the home position.

Referring particularly to Figures 5, 6, and 7, arrays 40, 41 comprise generally rectangular chips 100, the internal photosensitive or viewing elements of which extend longitudinally thereof to form a narrow viewing window 102. An adjustable array support assembly 101 is provided for each array. Each support assembly 101 includes a chip carrier 104 to which the array chip 100 is suitably attached as by means of adhesive. Carriers 104 are in turn attached to upper and lower floating blocks 106, 108 respectively as by means of screws 109.

Blocks 106, 108 are generally T-shaped with a central generally rectangular aperture 111 over which the array is secured, with outwardly extending side projections 112, 113. One interior face 115 of each projection 112, 113 rests against an adjustable support 116, 117. In the arrangement

shown, upper block 106 is inverted relative to lower block 108 with the result that supports 116, 117 for upper block 106 ride against the upper side 115 of projections 112, 113 of block 106, while the supports 116, 117 for lower block 108 ride against the lower surface 115 of projections 112, 113 and block 108. Supports 116, 117 each comprise a threaded member 120 bearing a contact pad 121 at one end thereof for engagement with the surface 115 of the block 106, 108 associated therewith.

Supports 116, 117 are threadedly engaged in generally U-shaped upper and lower block support plates 124, 126 respectively. Plates 124, 126 are in turn attached as by means of screws 127 to base members 128, 130 respectively. Springs 132 bias blocks 106, 108 toward and into engagement with the supports 116, 117 associated therewith. See Figure 7.

As will be understood, rotation of threaded members 120 of supports 116, 117 displaces the block 106, 108 and array 40, 41 associated therewith in a generally vertical direction to raise or lower the array relative to the optical path against the bias of spring 132. Rotation of the threaded member of support 116 or 117 only, or simultaneous rotation of the threaded members of both supports 116, 117 in opposite directions, effects a rotation or turning movement of the array supporting blocks to adjust the angle of the array relative to the horizontal.

To provide for adjustment of arrays 40, 41 in a direction parallel to the horizontal, an adjustable support 140, 142 is threadedly disposed in the upstanding end of each plate 124, 126 with contact pads 121' thereof projecting into engagement with the outer end of projections 113 of upper and lower blocks 106, 108. Spring 143 (Seen in Figure 7) biases blocks 106, 108 axially into contact with the adjustable support 140, 142 associated therewith.

Rotation of the threaded member 120' of support 140 or 142 displaces the block 106, 108 associated therewith axially in a direction parallel to the horizontal against the bias of spring 143 to adjust the position of the array 40 or 41 relative to the optical path.

Each array support assembly 101 is attached to the scan carriage frame 52 opposite lens 55 by means of a pair of externally threaded screw members 152, 154 and cooperating locking screws 160. Screw members 152 and 154 are threadedly engaged in internally threaded blocks 156, 158 carried on carriage frame 52. The terminal ends 151 of screw members 152,

154 facing the array support assemblies 101 are hollow and internally threaded at 159 for receipt of the externally threaded locking screws 160. Spacers 161 and spring washers 162 are provided on each blocking screw 160 to position the array support assemblies in predetermined lateral position relative to the locking screws. Holes 164, 165 in base members 128, 130 of array support assemblies 101 permit locking screws 160 to pass therethrough into threaded engagement with screw members 152, 154.

A generally spherically shaped recess 170 is provided in the face of each base member 128, 130 coaxial with hole 164. A vertical generally V-shaped recess 171 is provided in the face of each base member 128, 130 opposite hole 165. The terminal end 151 of screw member 152 is rounded off for receipt in recess 170 of base member 128, 130. Screw member 154 has a vertical semi-circular segment 174 rotatably disposed on the terminal end thereof for receipt in V-shaped recess 171 of block members 128, 130.

Alignment of arrays 40, 41 perpendicular to the optical path and focusing thereof is effected by selective rotation of screw members 152, 154 following attachment of the array support assemblies 101 to the ends of screw members 152, 154 and the carriage frame 52 by locking screws 160. Tightening of locking screws 160 draws the spherical end of screw member 152 in the spherical recess 170 and segment 174 on screw member 154 into V-shaped recess 171.

Simultaneous rotation of both screw members 152, 154 in the same direction moves the array support assembly 101 toward or away from lens 55 to adjust the array focus. Rotation of screw member 152 only causes the array support assembly 101 to pivot or rotate about the cylindrical segment 174 on screw member 154 to adjust the angular disposition of the array support assembly 101 relative to the optical path. To shield arrays 40, 41 from extraneous light, a flexible diaphragm 175 is disposed between lens 55 and the array support.

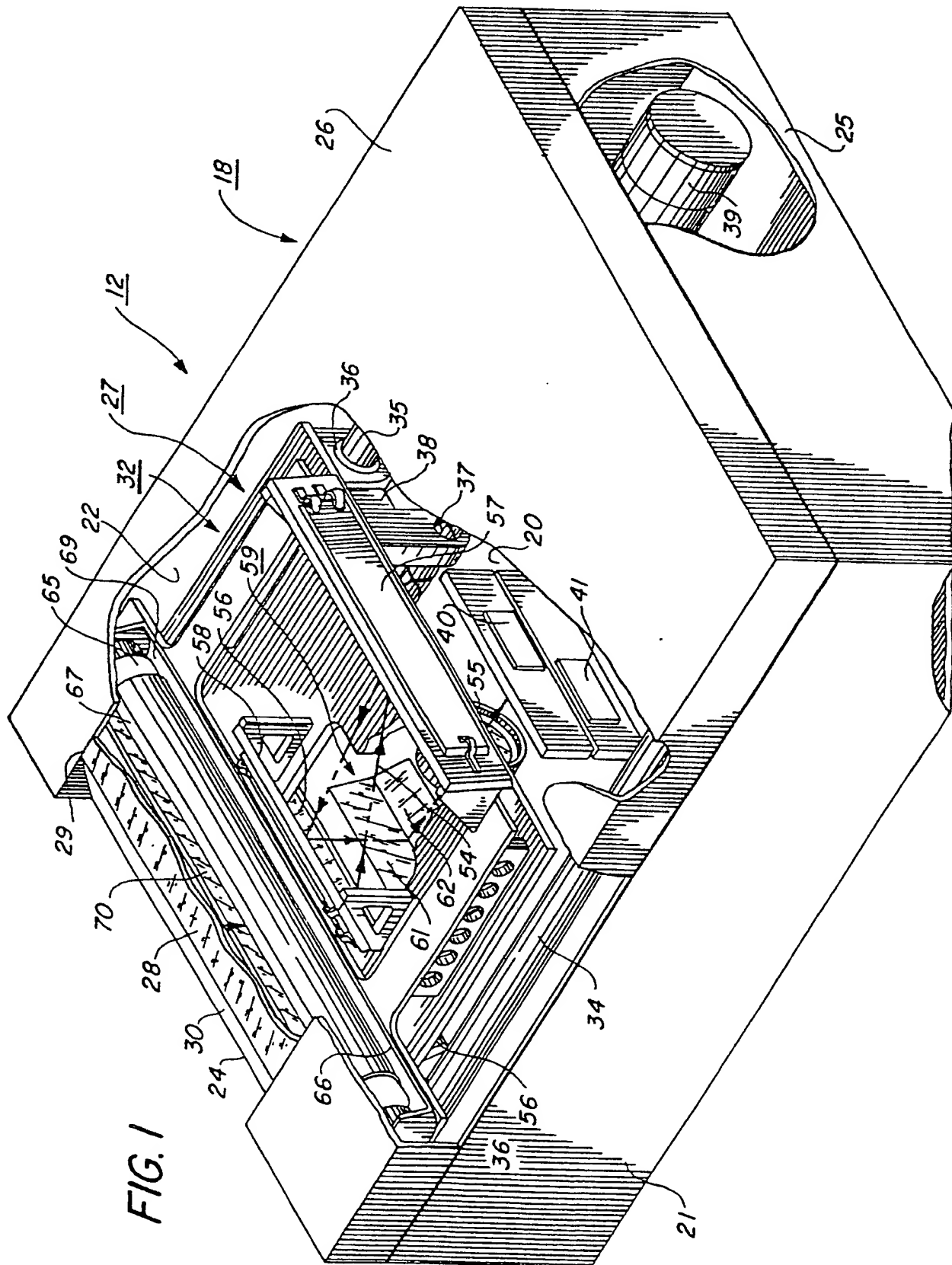
CLAIMS:

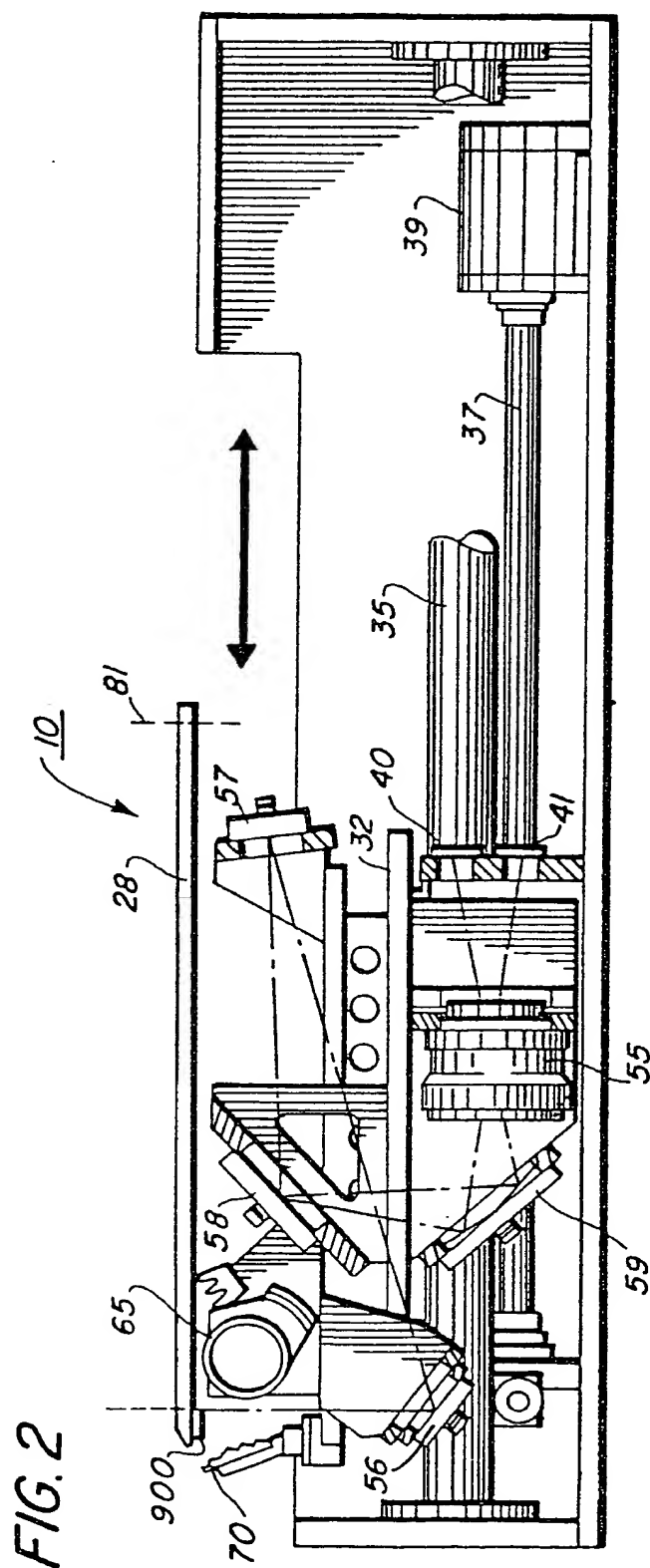
1. Array alignment apparatus for a raster scanner having a frame (18); at least one array (40) of image viewing elements; and optical means (55-59) forming a path for image rays to said array image viewing elements, characterized by:
 - a support (106, 108) for said array, said support being mounted on said frame for movement relative thereto, and
 - at least one focus adjusting member (152) on said frame and drivingly coupled to said support for moving said support together with said array in a direction paralleling the optical axis of said optical means.
2. The apparatus according to claim 1, characterized in that said focus adjusting member comprises first and second drive members (152, 154) on said frame and drivingly coupled to said support adjacent opposite ends thereof.
3. The apparatus according to claim 2, characterized by: pivot means (174) coupling said first drive member to said support whereby on adjusting movement of said second drive member (152), said support pivots about said first drive member to enable said array to be brought into perpendicular relationship with said optical axis.
4. The apparatus according to claim 2 or 3, characterized by: third and fourth drive members (116, 117) on said support and engageable with said array to support said array on said support, the axes of said third and fourth drive members being perpendicular to the axes of said first and second drive members, adjustment of said third and fourth drive members causing said array to move in a direction substantially perpendicular to said optical axis to adjust the height of said array viewing elements.
5. The apparatus according to claim 4, characterized by: bias means (132) for biasing said array into engagement with said third and fourth drive members.

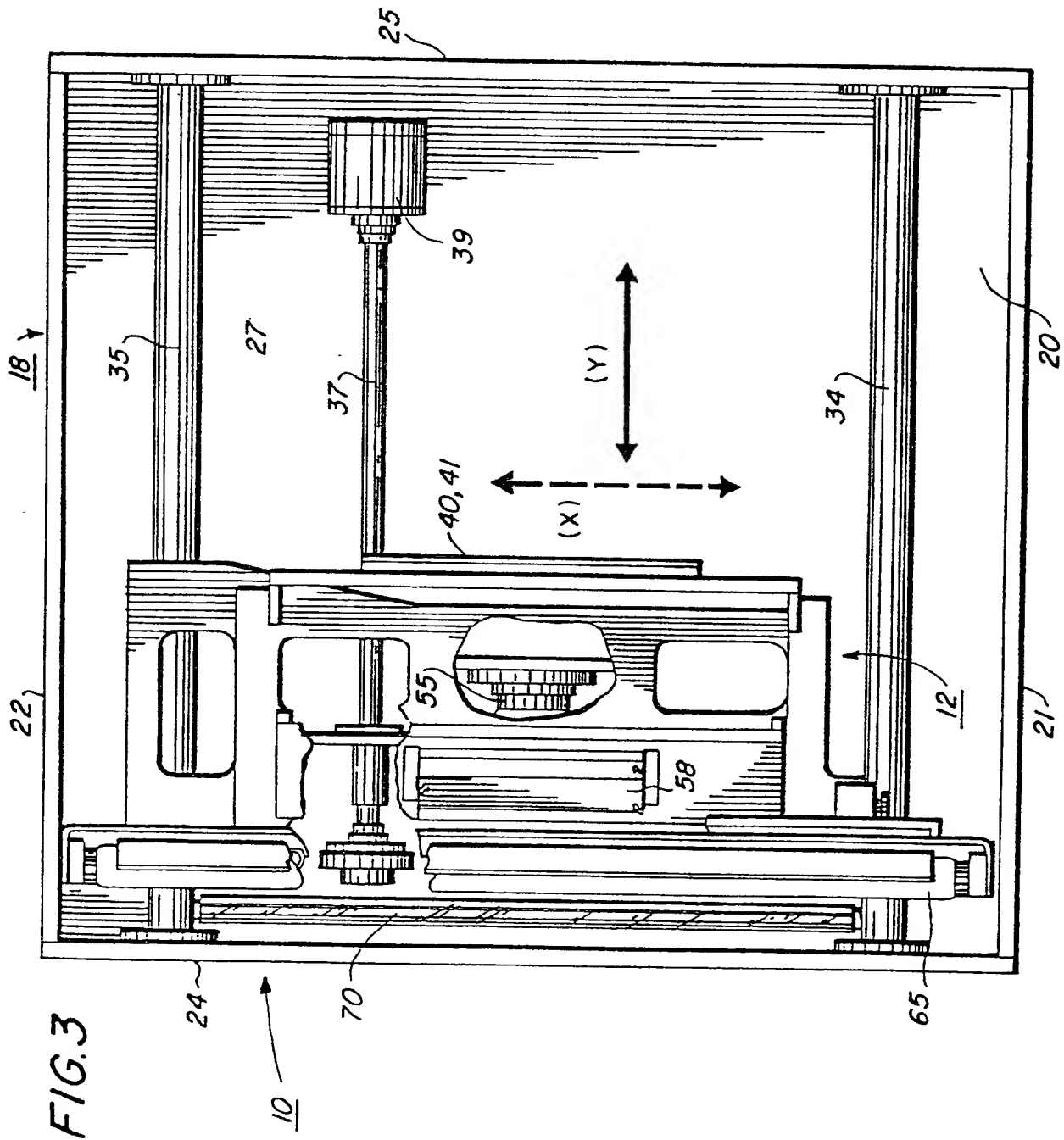
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6. The apparatus according to claim 4 or 5, characterized by: a fifth drive member (140) on said support, the axis of said fifth drive member being perpendicular to the axes of said third and fourth drive members, with said fifth drive member being engageable with said array at one end thereof, bias means (143) for biasing said array into engagement with said fifth drive member, adjustment of said fifth drive member moving said array in a direction substantially perpendicular to said optical axis to align said array image viewing elements with said optical axis.

7. The apparatus according to claim 6, characterized in that said third, fourth, and fifth drive members are differentially threaded.







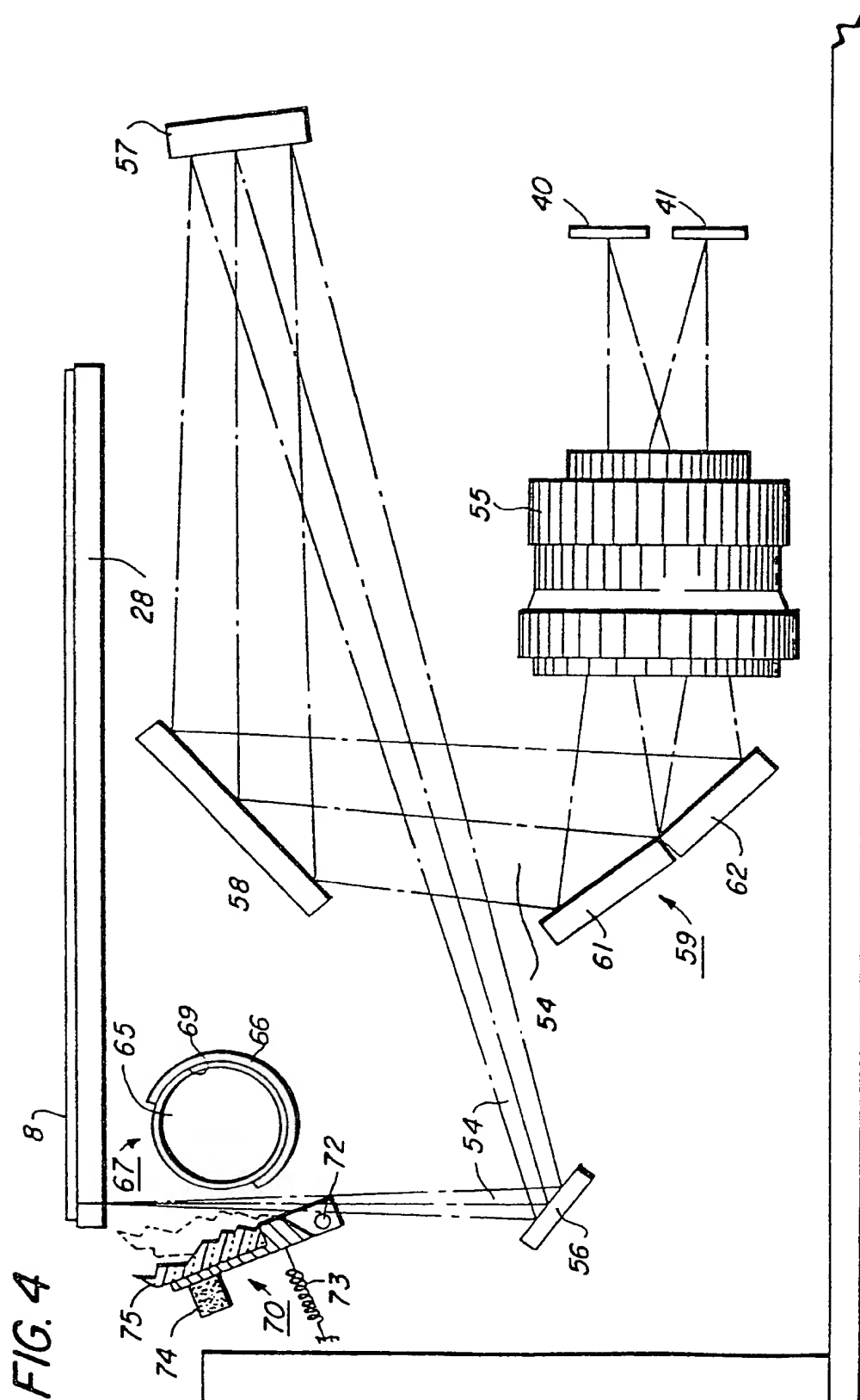


FIG. 5

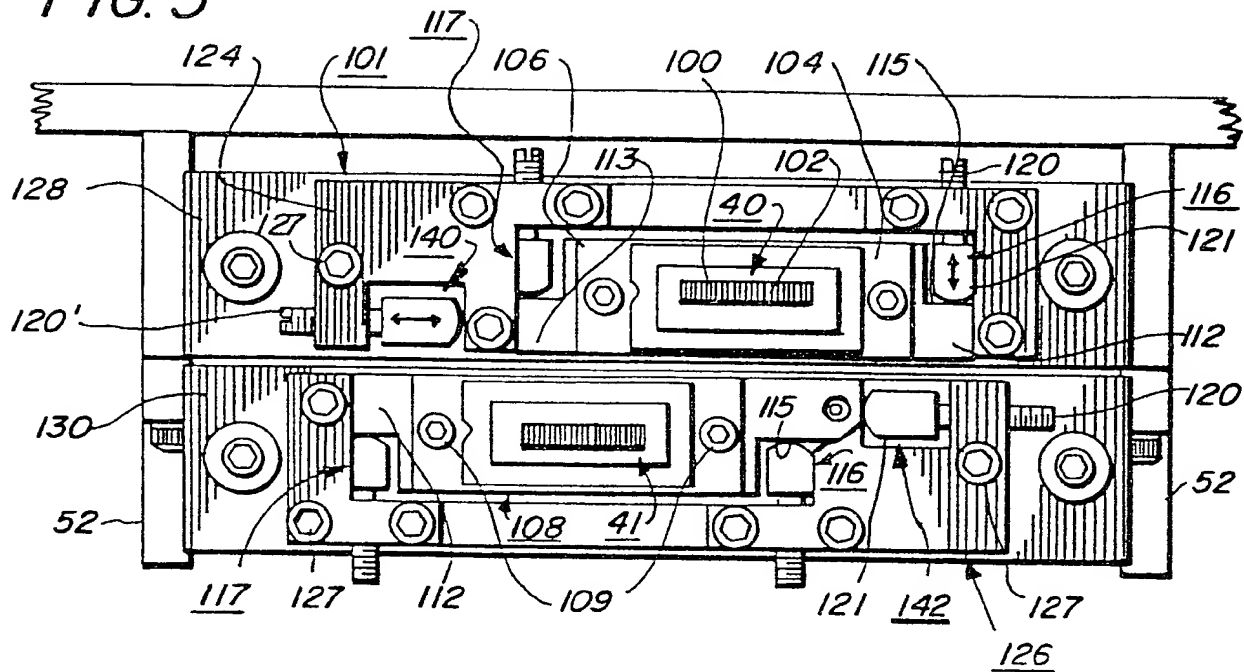
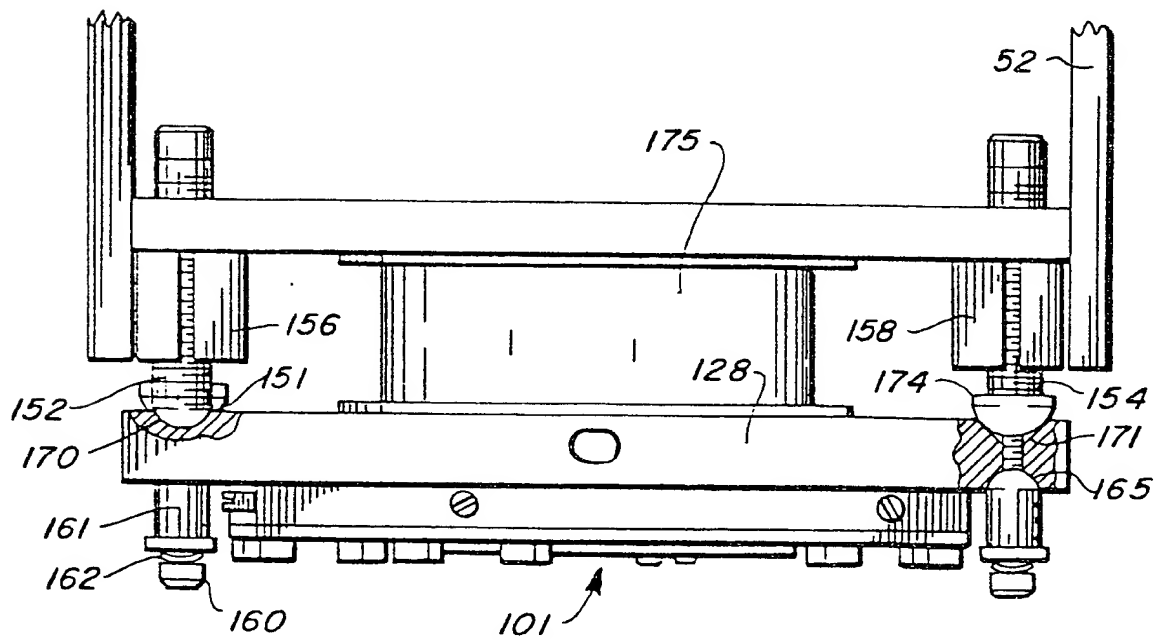


FIG. 6



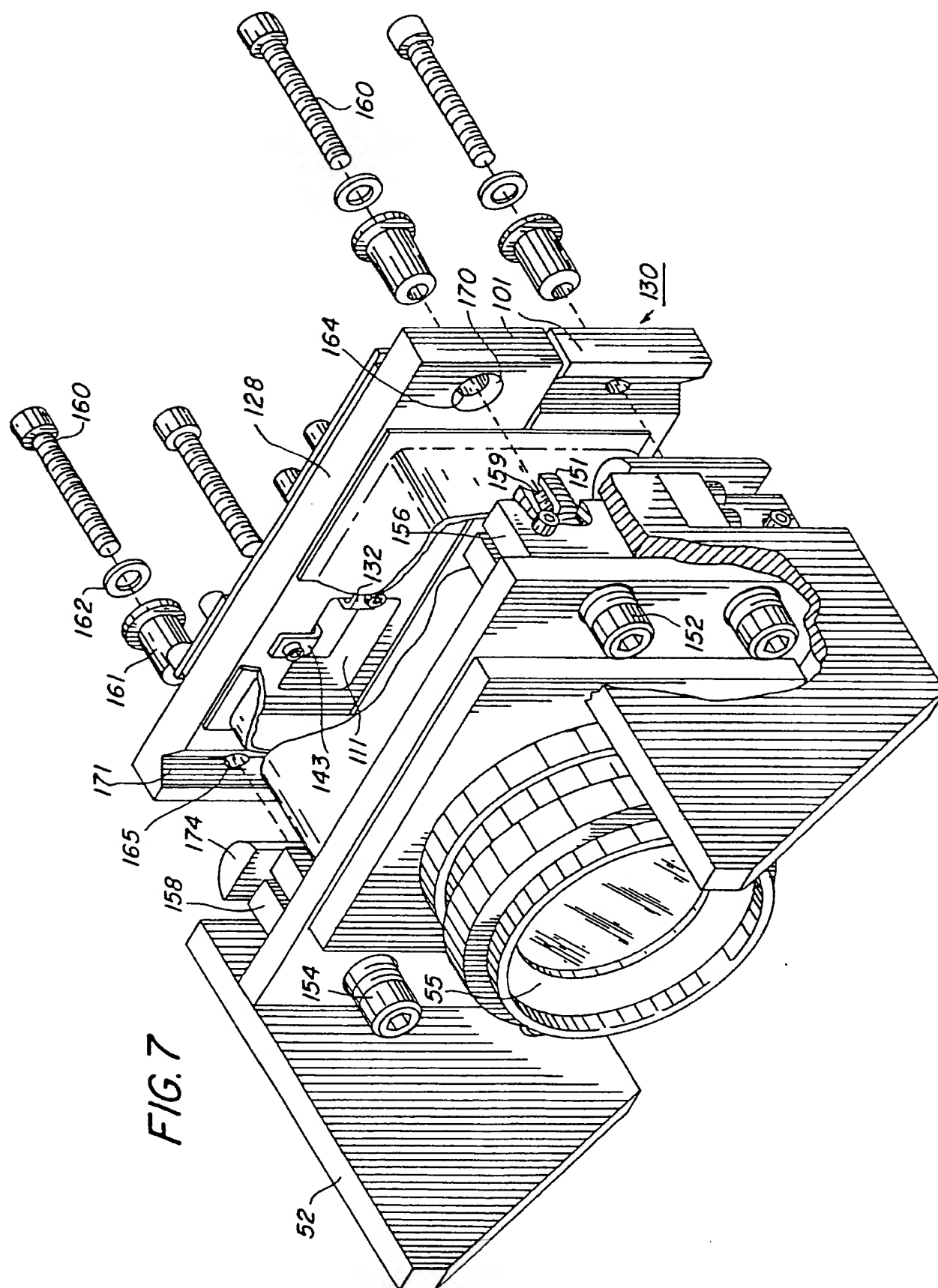


FIG. 7

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